MONITORING PLAN

PROJECT NO. TE-23 WEST BELLE PASS HEADLAND RESTORATION

ORIGINAL DATE: April 22, 1996
REVISED DATE: July 23, 1998

Preface

Pursuant to a CWPPRA Task Force decision on April 14, 1998, the original monitoring plan was reduced in scope due to budgetary constraints. Specifically, the goal to decrease water level variability was dropped, and water level monitoring and analysis were omitted. One additional pre-construction flight was added.

Project Description

The West Belle Pass Headland Restoration project is located in Lafourche Parish, Louisiana at latitude 29° 06'30" and longitude 90° 14'00", encompassing an area of 2,459 ac (995 ha) of coastal wetlands located adjacent to Port Fourchon. The project is bordered by Timbalier Bay on the west, Bayou Lafourche and Belle Pass to the east, and the Gulf of Mexico to the south (figure 1). The habitat type of the project is a combination of salt marsh and black mangrove wetlands. The salt marsh communities are dominated by *Spartina alterniflora* (smooth cordgrass), with a mixture of *Distichlis spicata* (salt grass), and *Spartina patens* (marshhay cordgrass). Natural and dredged channels throughout the project area are fringed by *Avicennia germinans* (black mangrove).

Historically, Bayou Lafourche, a major distributary of the Mississippi River, carried approximately 12% of the Mississippi River discharge until it was closed at Donaldsonville in 1904 as a flood protection measure (Reed 1995). There was no input of Mississippi River water into Bayou Lafourche until 1955. At this time, pumps were installed at Donaldsonville, maintaining a flow of 260 $ft^3 s^{-1}$ (7.36 cms) (van Heerden 1994). As Bayou Lafourche reaches the Gulf of Mexico, it splits into two passes, Pass Fourchon, to the east, and Belle Pass, to the west. In 1939, jetties were constructed at the mouth of Belle Pass in accordance with the River and Harbor Act of 1935. The River and Harbor Act of 1960 provided for the restoration and extension of the jetties and dredging of the pass to a channel depth of 12 ft (3.7 m). However, a deeper channel was needed to satisfy the local interests. The Greater Lafourche Port Commission obtained a permit from the U.S. Army Corps of Engineers to dredge a channel 20 ft (6.1 m) deep and 300 ft (91.4 m) wide. The work was completed in 1968. The extension and restoration of the 1939 jetties have accelerated beach erosion to the west (Williams et al. 1992).

Marshes in the project area have experienced an average relative sea level rise rate of 0.41 in yr^{-1} (1.04 cm yr^{-1}) (Penland and Ramsey 1990) and a wetland loss rate of 0.31 mi^2 yr^{-1} (0.8 km^2 yr^{-1}) (Dunbar et al. 1992). Local subsidence has caused a rim effect along pipeline canals, creating an impoundment of the interior marshes which has resulted in deterioration and loss of the vegetated wetlands (Penland et al. 1989). Changes to the Bayou Lafourche shoreline have occurred from wave

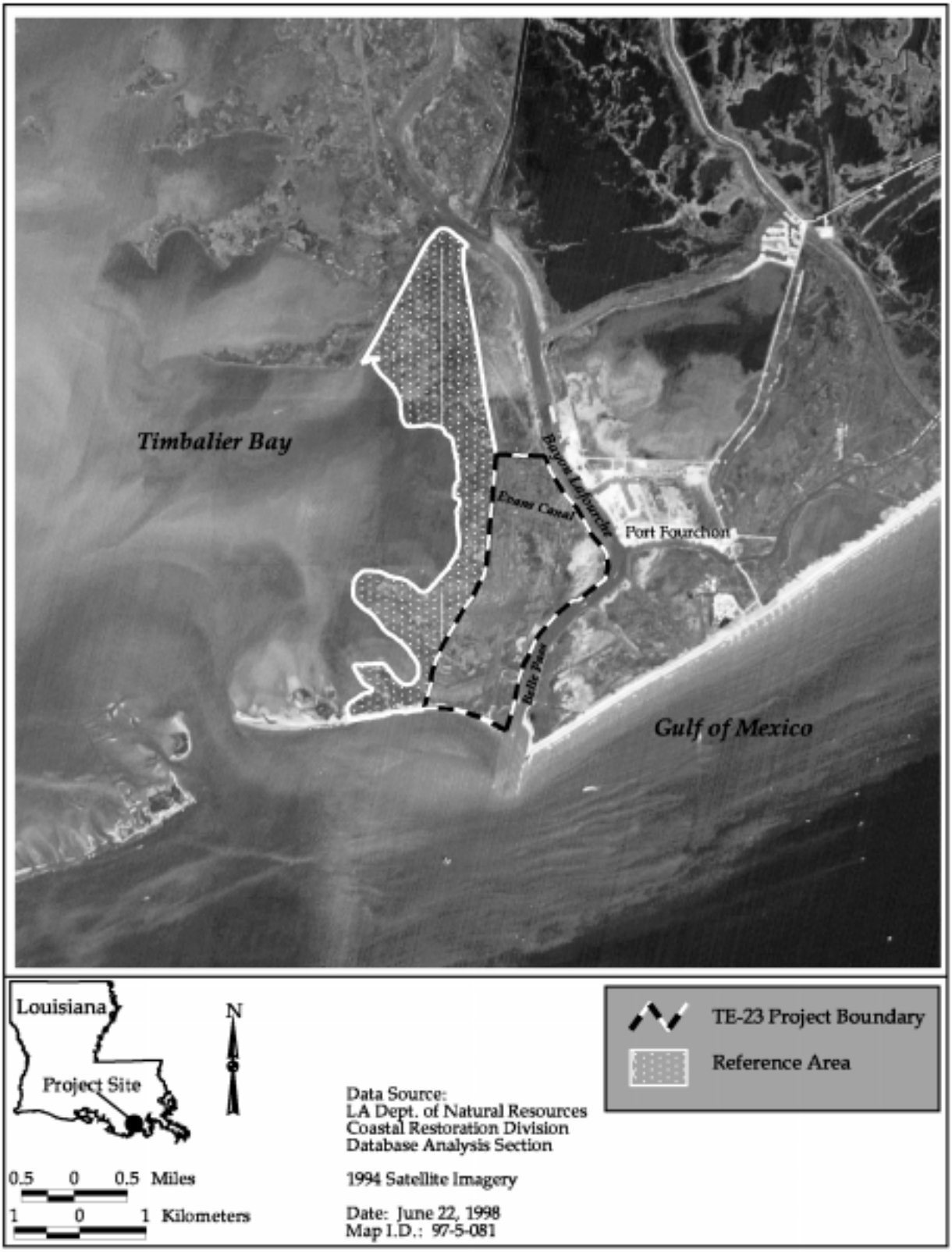

Figure 1. West Belle Pass Headland Restoration (TE-23) project area and reference area.

erosion due to boat traffic and tidal action. Wave action from boating traffic is severely eroding the bank along the western side of Bayou Lafourche. The shoreline erosion rate for the western side of the Belle Pass channel from 1983 to 1985 was approximately 20 ft yr^{-1} (6.1 m yr^{-1}) (Wicker et al. 1989). The average gulfside rate of change for the project and reference areas was 91.2 ft yr^{-1} (27.8 m yr^{-1}) for the period of 1887-1988 (Williams et al. 1992).

Timbalier Bay and Bayou Lafourche are hydrologically connected through Evans Canal and two pipeline canals within the northern portion of the project (see figure 1). Timbalier Bay has been encroaching on Bayou Lafourche through the marshes to the west. These openings in the marsh are expected to enlarge and accelerate the rates of erosion within the project area (Falgout 1992).

The West Belle Pass Headland Restoration project is designed to reduce the encroachment of Timbalier Bay into the marshes on the west side of Bayou Lafourche and Belle Pass. With the use of dredge materials, subaerial land will be created by filling in pipeline canals and open water areas. Additionally, old dams will be refurbished and new dams constructed along the dredged canals to allow stabilization of created and existing marsh. The project will also reduce shoreline retreat along the west bank of Bayou Lafourche and Belle Pass.

The project features (see figure 2) include:

1. The use of 2,700,000 cubic yards (2.06 million m^3) of dredged material from Bayou Lafourche to build 184 acres of subaerial land on the west side of Belle Pass.

2. Partial blockage of the Evans Canal using rock, and the construction of plugs on other designated dredged canals.

3. Existing plugs along pipeline canals will be refurbished.

4. Rubble mound rip rap will be placed on the west side of Belle Pass and Bayou Lafourche from the jetty north 17,000 ft (5,182 m).

Project Objectives

1. Reduce the encroachment of Timbalier Bay into the marshes on the west side of Bayou Lafourche and Belle Pass by creating 184 ac (74.5 ha) of wetlands.

2. Prevent further shoreline retreat along the west bank of Belle Pass and Bayou Lafourche using rip rap.

Specific Goals

The following goals will contribute to the evaluation of the above objectives:

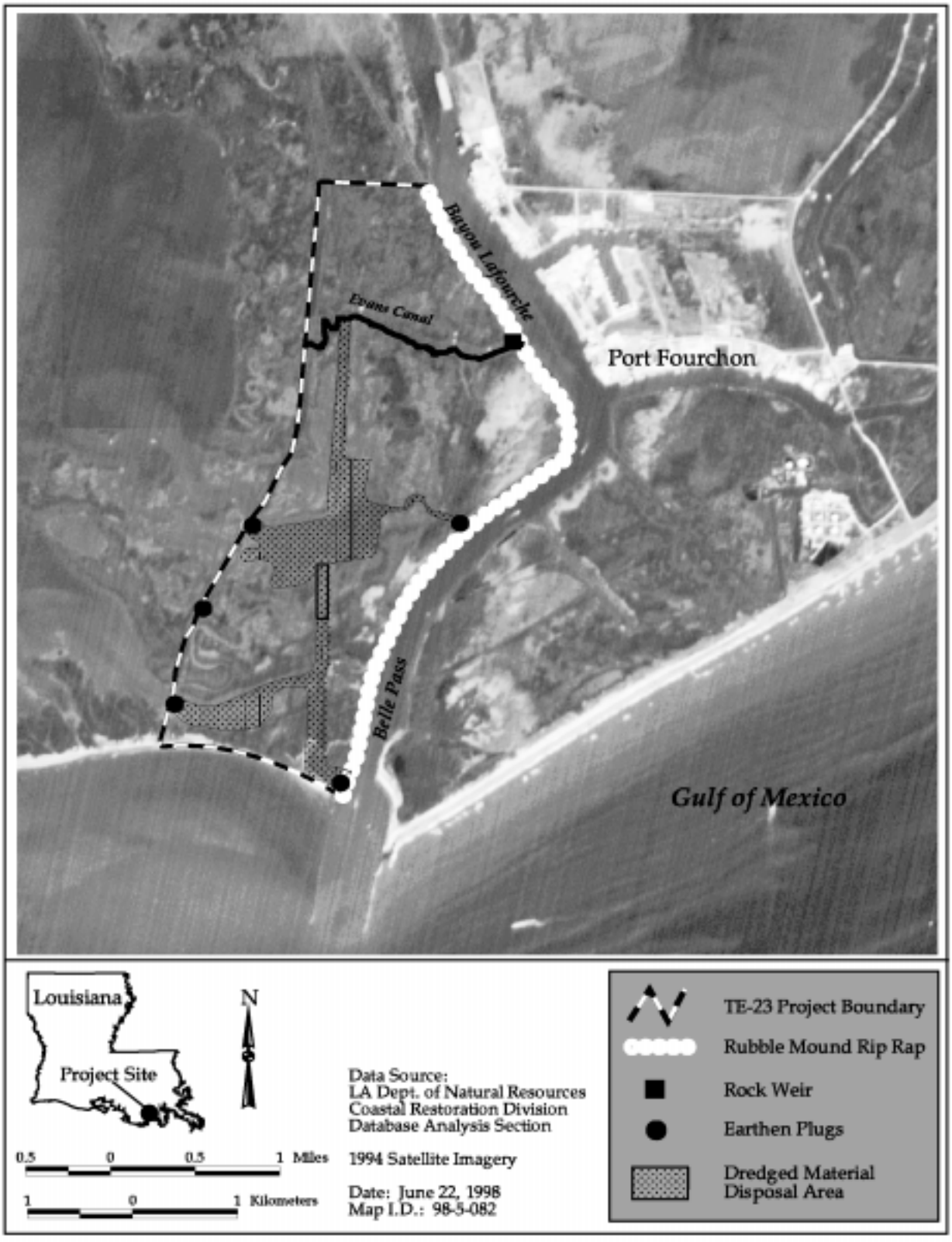

Figure 2. West Belle Pass Headland Restoration (TE-23) project area and features.

1. Create approximately 184 ac (74.5 ha) of marsh on the west side of Belle Pass through infilling of designated canals and shallow water bodies.

2. Increase the marsh to open water ratio.

3. Decrease the rate of shoreline retreat along the west bank of Belle Pass and Bayou Lafourche.

Reference Area

A reference area was chosen to compare the changes in marsh-to-open water ratios between the newly created and restored marsh to a marsh that mimics the preconstruction characteristics of the project area. The evaluation of possible reference areas was based on aerial photography and site investigations. Reference areas were ranked on the basis of their proximity to the project, plant communities, and soil types. The area west of Belle Pass, bordered by Timbalier Bay to the west, the Gulf of Mexico to the South, and the project area to the east was chosen as the reference area (figure 1). This area was chosen because it has similar vegetation and soils as the project. The reference area is dominated by *S. alterniflora* and possesses a similar mixture of other plant species found in the project. Although the reference area has many similarities to the project site, we recognize that interpretation of reference data can be limited or confounded by natural and anthropogenic processes.

No appropriate reference area could be located for the shoreline protection aspect of the project. The opposite shoreline of Bayou Lafourche has been historically used for depositing dredged material removed from Bayou Lafourche. The shoreline of Bayou Lafourche north of the project area does not receive the same level of boat traffic and associated influences found in the project area. It is felt that since the rip rap is to be placed directly on the shoreline, measurements of shoreline retreat from the rip rap will provide a measurement of the effectiveness of this aspect of the project.

Monitoring Elements

The following monitoring elements will provide the information necessary to evaluate the specific goals listed above:

1. Habitat Mapping — To document vegetated and non-vegetated areas, color infrared aerial photography (1:12000 scale with ground control markers) will be obtained. The photography will be photointerpreted, scanned, mosaicked, georectified,, and analyzed by National Wetlands Research Center (NWRC) personnel according to the standard operating procedure described in Steyer et al. (1995). The photography will be obtained in 1994 and 1997 (pre-construction), and post-construction in 2006 and 2017.

2. Shoreline Change — To evaluate marsh edge movement from the rip rap shoreline protection structure, aerial photography (1:12,000 scale) and GPS will be used to document marsh position along the west banks of Bayou Lafourche and Belle Pass. This information will provide a template for mapping shoreline position and shoreline changes over time. Several discrete stations will be established within the project area along the 17,000 ft (5,182 m) rock riprap shoreline protection structure. Points will be established on the actual structure as well as on the marsh edge adjacent to and behind the structure at maximum intervals of 500 ft (152 m) (35 points). In conjunction with the discrete readings, a continuous GPS reading will be taken for the entire shoreline protection structure. Additionally, historical rates (as meters per year loss) of erosion will be obtained (U.S. Army Corps of Engineers 1991) and compared to erosion rates after project implementation. GPS will be taken in 1998 (as-built) and in 2001, 2006, 2012 and 2017 post-construction.

Anticipated Statistical Analyses and Hypotheses

The following hypotheses correspond with the monitoring elements and will be used to evaluate the accomplishment of the project goals.

1. Descriptive and summary statistics on historical data (1956, 1978, 1988) and data from aerial photography and GIS interpretation collected during post-project implementation will be used to evaluate marsh to open water ratios and marsh loss rates for the natural marsh areas (not areas affected by introduction of dredged material). Data from aerial photography and GIS interpretation collected during post-project implementation will be used to evaluate the 184 acres of marsh created from dredged material. If sufficient historical information is available, regression analyses will be done to examine changes in slope between pre- and post-conditions.

   Goal: Create approximately 184 ac (74.5 ha) of marsh and increase the marsh to open water ratio.

   Hypothesis A:

   H_0: After project implementation at time point i, marsh to water ratios will not be significantly greater than at time point i-1.

   H_a: After project implementation at time point i, marsh to water ratios will be significantly greater than at time point i-1.

If we fail to reject the null hypothesis, any possible negative effects will be investigated.

Hypothesis B:

H_0: After project implementation at time point i, the percent of marsh loss in the project area will not be significantly less than the percent of marsh loss in the reference area.

H_a: After project implementation at time point i, the percent of marsh loss in the project area will be significantly less than the percent of marsh loss in the reference area.

If we fail to reject the null hypothesis, any possible negative effects will be investigated.

2. ANOVA's and multiple comparisons tests will be used to compare measured rates of shoreline movement with recent historical values for the area (from direct measurements of shoreline position relative to digitized coastal zone maps for 1956, 1978, and 1988). After several sets of data are acquired, ANOVA's will be used to compare site-specific shoreline movement within the project area.

Goal: Decrease the rate of shoreline retreat along the west bank of Belle Pass and Bayou Lafourche.

Hypothesis:

H_0: After project implementation at time point i, shoreline erosion rate will not be significantly less than at time point i-1.

H_a: After project implementation at time point i, shoreline erosion rate will be significantly less than at time point i-1.

Ecological effects will be evaluated in concert with statistical analyses to determine overall project success. If we fail to reject the null hypothesis, any possible negative effects will be investigated.

Notes:

1.	Implementation:	Start Construction:	December 1, 1997
		End Construction:	March 30, 1998
2.	COE Point of Contact	Richard Boe	(504) 862-1505

3.

DNR Project Manager:	Joe Saxton	(504) 342-6736
DNR Monitoring Manager:	Chris Borron	(504) 447-0996
DAS Assistant:	Chris Cretini	(504) 342-0277

4. The twenty year monitoring plan development and implementation budget for this project is $163,974. Comprehensive reports will be available in March 2002, March 2007, March 2013 and March 2018. These reports will describe the status and effectiveness of the project.

5. 1:12,000 color infrared aerial photography was flown in the fall of 1994.

6. A field investigation was undertaken in September 1994 by the previous Monitoring Manager and again in July of 1995 by the current Monitoring Manager to document vegetation.

7. References:

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